

A MATERIALS SYSTEMS APPROACH TO COMMERCIALIZATION

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Caterpillar's DOE "In-Cylinder Components" contract, with the objective of developing the technology for a heavy duty diesel engine with low emissions and a specific fuel consumption goal of 0.25 lb/bhp-hr, began eight years ago. Over the years, with significant DOE support, we have moved within striking distance of the program goal. It is also important to note that the goal is as valid today as it was when it was first established.

Market driven technology development recognizes multiple goals and seeks to serve the needs of society for clean air, decreases in energy consumption, reliable product and a viable manufacturing base.

The challenges we are now facing reflect similar quests that had confronted prior generations. In retrospect, progress to their challenges can now be better understood and recognized as systems changes. These changes focused not only on a single contribution such as new material but included innovations in manufacturing and design. Preceding these changes were laboratory breakthroughs in new materials and manufacturing knowledge, that were later transferred as guidelines or standards for design. Thus, understanding these critical success factors is a requirement for moving technology from the laboratory to the market.

As we look to the future and a 50% efficient Clean Diesel 50 (CD-50) program aimed at production in the early 2000's, we must pursue a balanced approach to meet emissions, fuel economy and sociability objectives.

We now have the opportunity to meet the demand for reduced fuel consumption through increased efficiency in performance, incorporating advances in design, materials and electronic controls.

Additionally, reducing fuel consumption can be significantly enhanced through power density. In this case, fuel savings combine with significant gains in payload revenue; every pound removed from the engine, without sacrificing performance, can be used as additional payload.

Full advantage of advanced materials will be realized when they are part of the engine systems design and not just substituted component for component. For example, the DOE ICC engine depends on a host of technologies for high fuel efficiency. The TTBC and FGCC insulation only increase fuel efficiency by 2-3 percent, but when leveraged with other advanced technology, they are a necessary part of the system that increases efficiency by up to 15%.

To achieve the goals of lower emission and fuel consumption, and meet increased customer

demands and expectations, information must be obtained for the following:

- * design data and guidelines must be established from material performance in an engine environment;**

- * failure mechanisms must be understood and coupled with design data and life prediction technology;**

- * process modeling must be developed further for efficient manufacturing of reliable parts;**

- * development of cost models that incorporate the influence of material and processing parameters.**

We will be successful in meeting the challenges we face if we continue to effectively leverage DOE funding as well as utilize the research expertise of academia.